NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

IRRIGATION WATER CONVEYANCE
ALUMINUM TUBING PIPELINE
(ft)
CODE 430AA

DEFINITION

A pipeline and appurtenances installed in an irrigation system.

PURPOSE

To prevent erosion or loss of water quality or damage to land, to make possible proper water use, and to reduce water conveyance losses.

CONDITIONS WHERE PRACTICE APPLIES

All pipelines shall be planned and located to serve as an integral part of an irrigation water distribution system designed to facilitate the conservation of water on a farm or group of farms.

All areas served by the pipelines shall be suitable for irrigation

Water supplies and irrigation deliveries to the area shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

CRITERIA

Working pressure. The maximum permissible working pressure in the line shall be determined by the following equation:

$$P = 2St/d$$

Where:

S = 7,500 lb/in.^{2}
P = Maximum working pressure in lb/in.^{2}
d = Inside diameter of tube in in.
t = Tube nominal wall thickness in in.

Capacity. Design capacity shall be based on whichever of the following is greater:

1. The capacity shall be adequate to deliver the volume of water required to meet the peak consumptive use of the crop.
2. The capacity shall be adequate to provide an adequate irrigation stream for all methods of irrigation planned.

For design purposes, the value of *n* in Manning's Formula shall be considered to be 0.01, except where joints, connections, and condition of the pipe indicate that a higher value is required.

Stands for low-pressure lines open to the atmosphere. Stands shall be used when water enters the pipeline to avoid entrapment of air; to prevent surge pressures and collapse because of vacuum failure; and to prevent pressure from exceeding the design working stress of the pipe. The stand shall be design to:

1. Allow a minimum of 1 ft of freeboard. The maximum height of the stand above the centerline of the pipeline must not exceed the maximum working head of the pipe.
2. Have the top of each stand at least 4 ft. above the ground surface except for surface gravity inlets, which shall be equipped with trash racks and covers.
3. Have a downward water velocity in stands not in excess of 2 ft/s. The inside diameter of the stand shall not be less than the inside diameter of the pipeline.

The cross sectional area of stands may be reduced above a point 1 ft above the top of the upper inlet, but the reduced cross section shall not be such that it would produce an average velocity of more than 10 ft/s if the entire flow were discharging through it.

If the water velocity of an inlet pipe exceeds three times the velocity of the outlet, the centerline of the inlet

shall have a minimum vertical offset from the centerline of the outlet at least equal to the sum of the diameters of the inlet and outlet pipes.

Sand traps, when combined with a stand, shall have a minimum inside dimension of 30 in. and shall be constructed so that the bottom is at least 24 in. below the invert of the outlet pipeline. The downward velocity of flow of the water in a sand trap shall not exceed 0.25 ft/s. Suitable provisions shall be made for cleaning sand traps.

The dimensions of gate stands shall be adequate to accommodate the gate or gates required and shall be large enough to make the gates accessible for repair.

The size of float valve stands shall be adequate to provide accessibility for maintenance and to dampen surge.

Stands must be constructed in a manner to insure vibration from the pump discharge pipe is not carried to the stand.

Vents for low-pressure lines open to the atmosphere. Vents must be designed into the system to provide for the removal of air and prevention of vacuum collapse. They shall:

1. Have a minimum freeboard of 1 ft above the hydraulic gradeline. The maximum height of the vent above the centerline of the pipeline must not exceed the maximum working head of the pipe.
2. Have a cross sectional area at least one-half the cross sectional area of the pipeline (both inside measurements) for a distance of at least one pipeline diameter up from the centerline of the pipeline. Above this elevation, the vent may be reduced to 2 in. in diameter.
3. Vents shall be located:
    a. At the downstream end of each lateral,
    b. At summits in the line,
    c. At points where there are changes in grade in a downward direction of flow of more than 10 degrees,
    d. Immediately below the pump stand the downward velocity in the stand exceeds 1 ft/s.
4. A combined air-release-vacuum-release valve may be used instead of an open vent. Air-vacuum release valves shall have a 2-in. minimum diameter. For lines 6 in. or less in diameter, 2-in. valves shall be used; for lines 7 in. through 10 in. in diameter, 3-in. valves shall be used; and for lines 12 in. in diameter, 4-in. valves shall be used.

Outlets. Appurtenances to deliver water from a pipe system to the land, a ditch, or any surface pipe system are known as outlets. Outlets shall have a capacity to deliver the required flow to (1) the hydraulic gradeline of a pipe or ditch or (2) a point at least 6 in. above the field surface.

Drainage. Provision shall be made to completely drain the pipeline. Drainage outlets should be provided at all low points in the system and may either discharge into a dry well or to a point of lower elevation. If these gravity discharge points are unavailable, provision shall be made to empty the line by pumping.

Check, pressure-relief, and air-and vacuum-release valves for high-pressure closed systems. A check valve shall be installed between the pump discharge and the pipeline if detrimental backflow may occur.

A pressure-relief valve shall be installed at the pump location if excessive pressure can build up when all valves are closed. Also, a surge chamber or a pressure-relief valve shall be installed in closed systems in which a check valve protects the line from reversal of flow and excessive surge pressure may develop. Pressure-relief valves shall be no smaller than ¼ in. nominal size for each diameter inch of the pipeline and shall be set at a maximum of 5 $lb/in.^2$ above the pressure rating of the pipe. If needed to relieve surge, pressure-relief valves or surge chambers shall be installed at the end of the pipeline.

Air-release and vacuum-release valves shall be placed at all summits in the pipeline and at the end of the line if needed to provide a positive means of air release valve or escape. Air-release and vacuum-release valve outlets of at least ½-in. nominal diameter shall be used in lines 4 in. or less in diameter, at least 1-in. outlets in lines 5 to 8 in. in diameter, and at

least 2-in. outlets in lines 10 to 16 in. in diameter.

Joints and connections. All connections shall be constructed to withstand the working pressure of the line without leakage and to leave the inside of the line free of any obstructions that can reduce the line capacity below design requirements. All such fittings as risers, ells, tees, and reducers should be of similar metal. If dissimilar metals are used, however, the fittings shall be protected against galvanic corrosion. For example, separate dissimilar metals with a rubber or plastic insulator. The connection between the pump discharge pipe and the aluminum line shall be made of suitable insulating material, such as rubber or plastic.

Quality of water. Water-quality tests shall be made for all aluminum pipeline installations. A copper content in excess of 0.02 p/m produces nodular pitting and rapid deterioration of the pipe if water is allowed to remain stagnant.

Materials. Pipe and coating materials shall equal or exceed the physical requirements specified under "Materials".

Thrust Control. Abrupt changes in pipeline grade, horizontal alignment, or reduction in size require an anchor or thrust blocks to absorb any axial thrust of the pipeline.

Thrust blocks shall have a minimum thickness of six inches and a minimum height equal to the outside diameter of the pipe. The blocks shall fill the space between the pipe and the undisturbed earth at the side of the trench at bends and tees. Blocks at ends of lines shall bear against undisturbed earth or earth compacted at least to the density of the surrounding natural material. Blocks at ends of lines where the maximum working head exceeds 25 ft. shall be reinforced concrete.

The area of thrust block required is given by the following formula:

$$A = (98\ HD2 / B) * \sin (a / 2)$$

Where:

H = Maximum working head in feet.

D = inside diameter of pipe in feet.

B = Allowable passive pressure of the soil in lbs per sq. ft. as follows:

Table 1.—Allowable soil bearing pressure

Natural soil material	*Depth of cover to center of thrust block*			
	2 ft	*3 ft*	*4 ft*	*5 ft*
	----------lb/ft2----------			
Sound bedrock	*8,000*	*10,000*	*10,000*	*10,000*
Dense sand and gravel mixture (assumed Ø = 40º)	*1,200*	*1,800*	*2,400*	*3,000*
Dense fine to coarse sand (assumed Ø = 35º)	*800*	*1,200*	*1,650*	*2,100*
Silt and clay mixture (assumed Ø = 25º)	*500*	*700*	*950*	*1,200*
Soft clay and organic soils (assumed Ø = 10º)	*200*	*300*	*400*	*500*

a = Deflection angle of pipe bend (at ends of lines a = 180º).

Anchors and thrust blocks shall be constructed of either:

1. Concrete poured to fill the space between the pipe and the undisturbed earth at the side of the trench on the outside of bends.

2. Soil cement with at least one part cement to 12 parts of sandy loam or coarser texture soil, placed to fill the space between the pipe and the undisturbed earth at the side of the trench. The . The material shall be thoroughly mixed and tamped on the outside of bends in a moist condition to set the cement.

CONSIDERATIONS

Water Quantity

1. Effects on the components of the water budget, especially infiltration and evaporation.
2. Effects on downstream flows or aquifers that would affect other water uses or users.
3. Potential use for irrigation water management.
4. Effects of installing a pipeline on vegetation that may have been located next to the original conveyance.

Water Quality

1. Effects of installing the pipeline (replacing other types of conveyances) on channel erosion or the movement of sediment and soluble and sediment-attached substances carried by water.

2. Effects on the movement of dissolved substances into the soil and on percolation below the root zone or to ground water recharge.

3. Effects of controlled water delivery on the temperatures of water resources that could cause undesirable effects on aquatic and wildlife communities.

4. Effects on wetlands or water-related wildlife habitats.

5. Effects on the visual quality of water resources.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing aluminum tubing irrigation pipelines shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purposes.

OPERATIONS AND MAINTENANCE

An operation and maintenance plan must be prepared for use by the owner or others responsible for operating the system. The plan should provide specific instructions for operating and maintaining the system to insure that it functions properly. It should also provide for periodic inspections and prompt repair or replacement of damaged components.